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WASTEWATER ENGINEERING AND MANAGEMENT PLAN

FOR

BOSTON HARBOR - EASTERN MASSACHUSETTS METROPOLITAN AREA

EMMA STUDY

TECHNICAL DATA VOL. 4
WATER ORIENTED WASTE WATER UTILIZATION CONCEPTS

OCTOBER 1975

INDEX TO EMMA STUDY REPORTS

BROCHURE

SUMMARY REPORT

MAIN REPORT

TECHNICAL DATA VOLUMES

1	PLANNING CRITERIA
2	ENGINEERING CRITERIA
3	INDUSTRIAL PROCESS WASTEWATER ANALYSIS AND REGULATION
3A	STUDY OF CERTAIN INDUSTRIAL WASTES
3B	STUDY OF WASTES FROM LARGE INDUSTRIES
4	WATER ORIENTED WASTEWATER UTILIZATION CONCEPTS
5	LAND ORIENTED WASTEWATER UTILIZATION CONCEPT
6	FORMULATION OF WASTEWATER UTILIZATION PLAN
7	COMBINED SEWER OVERFLOW REGULATION
8	URBAN STORMWATER MANAGEMENT
8A	APPENDIX TO URBAN STORMWATER MANAGEMENT
9	MDC INTERCEPTOR AND PUMPING STATION ANALYSIS AND IMPROVEMENTS
10	DEER ISLAND WASTEWATER TREATMENT PLANT ANALYSIS AND IMPROVEMENTS
11	NUT ISLAND WASTEWATER TREATMENT PLANT ANALYSIS AND IMPROVEMENTS
12	FINANCING AND MANAGEMENT
13	IMPACT ANALYSIS AND EVALUATION
13A	BIOLOGICAL IMPACT ANALYSIS
13B	SOCIO-ECONOMIC IMPACT ANALYSIS
13C	HYGIENIC IMPACT ANALYSIS
13D	VISUAL, CULTURAL AND DESIGN IMPACT ANALYSIS
14	PUBLIC INVOLVEMENT
15	RECOMMENDED PLAN AND IMPLEMENTATION PROGRAM
16	AGENCY REVIEWS

(6)

WASTEWATER ENGINEERING AND MANAGEMENT PLAN FOR BOSTON HARBOR – EASTERN MASSACHUSETTS METROPOLITAN AREA EMMA STUDY.

TECHNICAL DATA [redacted] Volume 4. WATER ORIENTED WASTEWATER DISPOSAL CONCEPTS.

FOR THE

METROPOLITAN DISTRICT COMMISSION

COMMONWEALTH OF MASSACHUSETTS

BY

METCALF & EDDY, INC.

(11) OCTOBER 1975

(12) 61p.

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TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

LIST OF TABLES

LIST OF FIGURES

REPORT

CHAPTER 1

INTRODUCTION

Purpose

Forty three cities and towns now belong to the Metropolitan Sewerage District which is administered by the Metropolitan District Commission (MDC). The MDC maintains primary sewage treatment plants at Deer Island and Nut Island in Boston Harbor and about 225 miles of trunk lines, 11 pumping stations and four headworks. The primary treatment plants are operating at capacity. The MDC has agreed to expand and upgrade them with secondary treatment plants. The first step in doing so is to determine how many communities should in the future be served by the upgraded Deer Island and Nut Island sewage treatment plants. Therefore, the MDC has undertaken a study of anticipated wastewater management problems in 109 communities of the Eastern Massachusetts Metropolitan Area (EMMA) to make this determination.

Scope

Under the guidance of four alternative engineering concepts established prior to the start of this project and stated hereinafter, all EMMA communities have been investigated to determine sewerage needs and opportunities relative to service by an expanded or contracted Deer and Nut Island treatment plant service area which are briefly described as follows:

Concept No.	Concept description
Concept 1	No expansion, upgrading systems within the present service area of the Deer and Nut Island treatment plants.
Concept 2	Limited expansion or contraction of the Deer and Nut Island treatment Plant service area.
Concept 3	Maximum expansion of the Deer and Nut Island treatment plant service area.

Concept No.	Concept description
Concept 4	Decentralization of treatment by construction of additional treatment plants within present service areas and systems.

The present systems and activities were reviewed within EMMA to form the basis for service configurations.

Other general considerations included are listed below:

1. Systems must be financially and technically feasible using present-day technology.

2. Insofar as possible existing treatment plants and interceptors must be incorporated into any regional systems for economy of operations.

3. Regionalization must be sufficiently flexible to accommodate immediate needs economically.

4. Timing of future sewerage needs must be considered in developing regional service configurations.

5. Existing municipal systems should be retained where they are adequate to meet future needs, and can not reasonably be incorporated into a regional system.

6. Retention of discharges in the basin of origin must be considered as important.

7. Receiving waters must be considered both in terms of quality and flow requirements.

It is not intended that any one of these concepts in total would become the final plan. The concepts, however, provide information that would lead to the selection of a final plan.

The community groupings and water pollution control plant locations for each concept are described in detail in this report.

Report Structure

As shown on the inside cover, the study results are presented in a series of volumes. The criteria used in

quantifying alternative concepts are presented in Technical Data Volumes 1 and 2. Volumes 9, 10 and 11 give the upgrading requirements for the various MDC facilities.

This report, ~~Technical Data Volume 4~~, presents four water oriented service system concepts with Technical Data. Volume 5 presenting the land oriented wastewater utilization concept.

This report is arranged in the following format. The introduction is presented to give a brief description of the study area. This is followed by a detailed discussion of the four conceptual engineering plans. The first sections of the chapters relating to the concepts present an overview of the plans noting advantages and disadvantages. This is followed by a discussion of those facilities that are located within the service area of the Deer Island and Nut Island sewage treatment plants, and the regional and municipal treatment systems that are located outside of this service area.

The communities outside the Deer Island and Nut Island treatment plant service areas have been divided into satellite and peripheral areas. Satellite areas denote communities that may be included in service areas for the Deer and Nut Island treatment plants as part of the maximum expansion concept (Concept 3).

Peripheral areas denote those communities that would not be served by the Deer Island and Nut Island treatment systems.

In the final chapter, an analysis is presented of the feasibility of regionalization of sludge management using Concept 4 as the basis.

CHAPTER 2

CONCEPT 1 - UPGRADING SYSTEMS OF THE EXISTING DEER AND NUT ISLAND TREATMENT PLANTS SERVICE AREA

General

This plan follows the concept of upgrading the Metropolitan District sewerage facilities to provide for future needs within its present service area, and utilizes regional and municipal systems to serve the remaining communities within the study area. There are several communities that would, however, become part of the Deer and Nut Island treatment plant service area under this concept because no other reasonable solutions exist for them. The systems considered for servicing the remaining communities are based on retaining wastewater in the basin of origin. Figure 2-1 shows the community groupings for sewerage service under this concept.

Description of the Plan

Nut and Deer Island wastewater treatment plants would ultimately serve 50 communities including the core cities of Boston, Cambridge, Chelsea, Everett, and Somerville. The existing Metropolitan District interceptors would be extended to provide service to the municipalities of Hopkinton, Lincoln, Lynnfield, Sharon and Weston since all of these towns are expected to require sewer service by the year 2000. After 2000, Dover and Sherborn would be expected to join these communities and are included because they are tributary to municipalities that are presently served by the Deer and Nut Island treatment plants and because they cannot be reasonably included in any of their adjacent systems.

Table 2-1 lists the municipalities that would be tributary wholly or in part to the Deer Island or Nut Island treatment plants.

The remaining 59 communities within the study area could be served by regional and municipal systems, which are described later in this chapter.

Cost of Plan

The approximate cost of providing treatment facilities and intermunicipal interceptor sewers, when applicable,

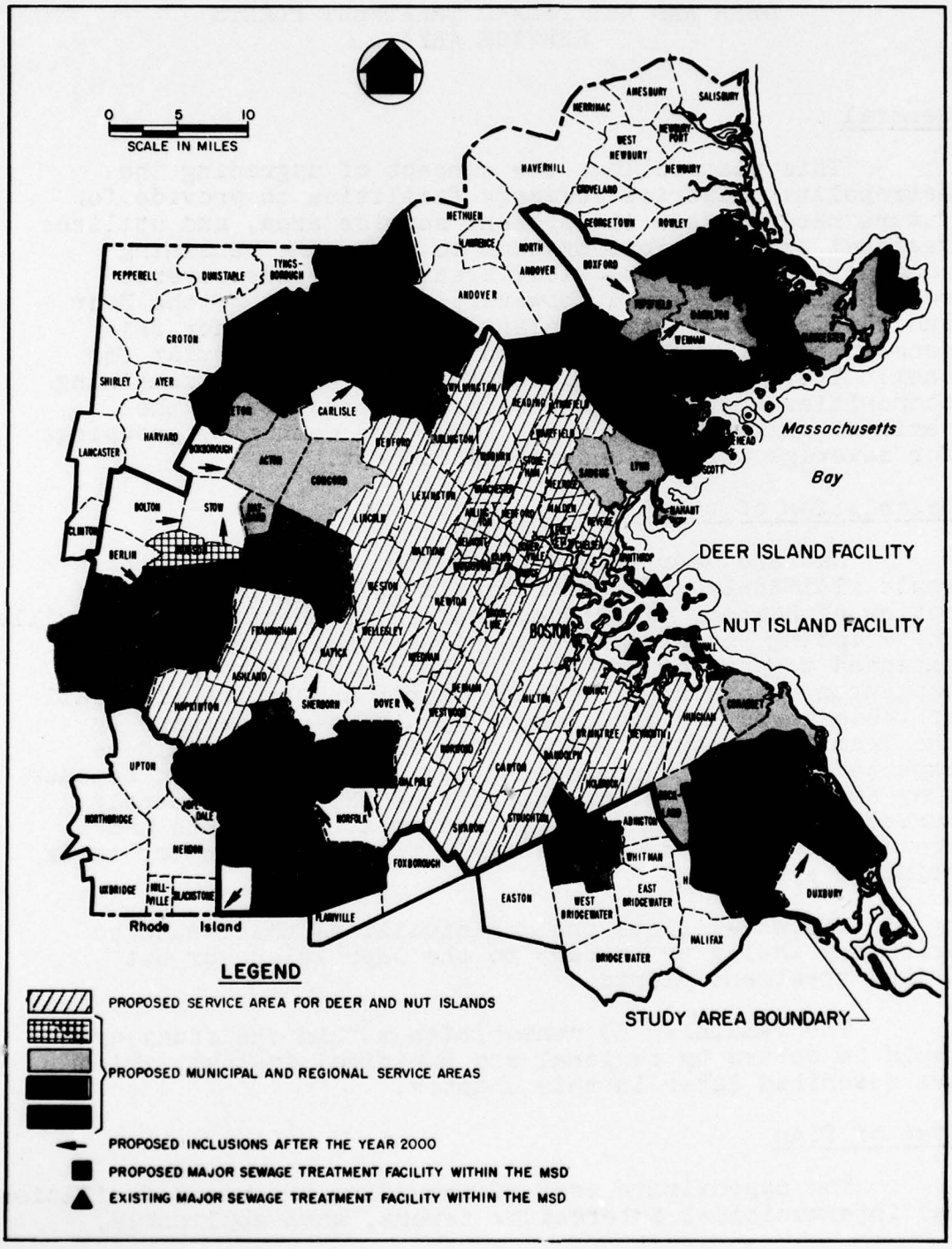

FIG. 2-1 CONCEPT 1 - A REGIONAL PLAN UPGRADING SYSTEMS OF THE EXISTING DEER AND NUT ISLAND SERVICE AREA

under Concept 1 is on the order of $994 million. A breakdown by major components of this estimate is presented in Table 2-2.

TABLE 2-1. MUNICIPALITIES TRIBUTARY TO DEER OR NUT ISLAND WASTEWATER TREATMENT PLANTS UNDER CONCEPT 1

Tributary to Nut Island	Tributary to Deer Island
Ashland	Arlington
Boston (in part)	Bedford
Braintree	Belmont
Brookline (in part)	Boston (in part)
Canton	Brookline (in part)
Dedham	Burlington
Dover (after year 2000)	Cambridge
Framingham	Chelsea
Hingham	Everett
Holbrook	Lexington
Hopkinton	Lincoln
Milton (in part)	Lynnfield
Natick	Malden
Needham	Medford
Newton (in part)	Melrose
Norwood	Milton (in part)
Quincy	Newton (in part)
Randolph	Reading
Sharon	Revere
Sherborn (after year 2000)	Somerville
	Stoneham
Stoughton	Wakefield
Walpole	Waltham
Wellesley	Watertown
Westwood	Weston
Weymouth	Wilmington
	Winchester
	Winthrop
	Woburn

Metropolitan Sewerage Facilities

Under this concept both the North (tributary to Deer Island) and South (tributary to Nut Island) Metropolitan District Systems are retained. The North system would be expanded to serve Lynnfield, Weston and Lincoln,

TABLE 2-2. SUMMARY OF CAPITAL AND OPERATION COSTS FOR CONCEPTS 1 THROUGH 4

System	Capital costs (millions of $) Con. 1	Con. 2	Con. 3	Con. 4
Deer and Nut Island WWTP service area improvements				
1. Deer Island WWTP	260	236	260	194
2. Nut Island WWTP	231	135	248	146
3. Pumping Stations	19	19	19	19
4. Interceptors - Present	118	49	160	57
- Future	47	17	138	15
Subtotal	675	456	825	431
Local share	67.5	45.6	82.5	43.1
Satellite area systems				
1. Treatment plants	31	247	None	336
2. Interceptors and pumping stations	20	28	None	31
Subtotal	51	275	None	367
Local share	5.1	27.5	None	36.7
Subtotal Deer and Nut Island and Satellite area systems				
Subtotal	726	731	825	798
Local share	72.6	73.1	82.5	79.8
Peripheral area systems				
1. Treatment plants	182	182	182	182
2. Interceptors and pumping stations	86	86	86	86
Subtotal	268	268	268	268
Local share	26.8	26.8	26.8	26.8
Grand total				
Complete cost	994	999	1093	1066
Local share	99.9	99.9	109.3	106.6

System	Operation and maintenance costs (millions of $) Con. 1	Con. 2	Con. 3	Con. 4
Deer and Nut Island WWTP service areas	17	15	17	14
Satellite area systems	4	24	1	33
Subtotal Deer and Nut Island and Satellite area systems				
Subtotal	21	39	18	47
Peripheral area systems	17	17	17	17
Total annual operation and maintenance costs	38	56	35	64

GENERAL NOTES:

1. Deer and Nut Island service areas include those municipalities tributary to Deer and Nut Island wastewater treatment plants under each concept as shown on the appropriate figures.
2. Satellite area systems vary with the change in the Deer and Nut Island service areas and include present or possible MDC members.
3. Peripheral area systems include the remaining municipalities in the Study Area.
4. Local share costs represent that portion to be paid locally. Ninety (90) percent of the costs are funded by Federal and state grants.
5. Costs do not include local collection sewers.
6. Costs are at present day prices (ENR 2200) and include engineering and contingencies.

and the total flow from this system would be conveyed to Deer Island for treatment before discharge to the open sea. The south system would also be expanded to serve Sharon and Hopkinton, and the total flow would be treated at Nut Island before discharge to the outer harbor. This concept follows the historical plan of development of the Metropolitan District System, and in the past this type of development has afforded some economies of operation due to size. Even with today's treatment standards, a similar cost advantage may still be realized. This concept has the disadvantage that it would require substantial quantities of costly fill at Nut and Deer Islands to provide sufficient site for the expanded plant facilities.

Regional-Municipal Systems

The regional and municipal systems that are shown on Figure 2-1 are presented in Table 2-3 by drainage basin or existing regions, together with the estimated 2000 design flows. Each of the drainage basins is then discussed in the paragraphs that follow.

TABLE 2-3. DRAINAGE BASINS, THEIR TRIBUTARY MUNICIPALITIES AND PROJECTED FLOWS FOR THE YEAR 2000

River basin	Year 2000 flow	Wastewater treatment plant Location	Year 2000 design flow
Saugus River Drainage Basin			
Saugus	4.0 mgd		
Lynn	18.9 mgd	Lynn	24.0 mgd
Lynnfield	To MDC Deer Island		
Nahant	1.1 mgd		
South Essex Sewerage District			
Beverly	9.0 mgd	Salem	47.4 mgd
Danvers	6.7 mgd		
Marblehead	4.2 mgd		
Peabody	17.3 mgd		
Salem	10.2 mgd		

TABLE 2-3 (Continued). DRAINAGE BASINS, THEIR TRIBUTARY MUNICIPALITIES AND PROJECTED FLOWS FOR THE YEAR 2000

River basin	Year 2000 flow	Wastewater treatment plant Location	Year 2000 design flow
North Coastal Drainage Basin			
Essex	0.4 mgd		
Gloucester	5.8 mgd		
Manchester	1.6 mgd	All are individual municipal facilities located in each municipality.	
Rockport	1.4 mgd		
Swampscott	3.2 mgd		
Ipswich River Drainage Basin			
Boxford	Note 1		
Hamilton	0.8 mgd	Hamilton	1.4 mgd
Topsfield	0.6 mgd		
Wenham	Note 1		
Ipswich	2.4 mgd	Ipswich	2.4 mgd
Middleton	0.8 mgd	Middleton	2.4 mgd
North Reading	1.6 mgd		
Merrimack River Drainage Basin			
Chelmsford	(90%)[2] 3.8 mgd	To Lowell WWTP	
Tewksbury	4.8 mgd		
Concord River Drainage Basin			
Acton	2.4 mgd		
Boxborough	Note 1		
Concord	3.4 mgd	Concord	8.3 mgd[1]
Littleton	0.9 mgd		
Billerica	6.4 mgd	Billerica	6.4 mgd
Carlisle	Note 1		

TABLE 2-3 (Continued). DRAINAGE BASINS, THEIR TRIBUTARY MUNICIPALITIES AND PROJECTED FLOWS FOR THE YEAR 2000

River basin	Year 2000 flow	Wastewater treatment plant Location	Year 2000 design flow
Stony Brook Drainage Basin			
Chelmsford	(10%) 0.4 mgd	Chelmsford	2.1 mgd
Littleton	(50%) 0.5 mgd		
Westford	1.2 mgd		
Assabet River Drainage Basin			
Berlin	Note 1		
Marlborough	(20%) 1.2 mgd	Marlborough	9.3 mgd
Northborough	1.9 mgd		
Shrewsbury	3.5 mgd		
Westborough	2.7 mgd		
Bolton	Note 1		
Hudson	2.9 mgd	Hudson	3.9 mgd
Stow	Note 1		
Maynard[2]	2.0 mgd	Concord	8.3 mgd
Sudbury River Drainage Basin			
Marlborough	(80%) 4.8 mgd	Marlborough	5.8 mgd
Southborough	1.0 mgd		
Sudbury	2.9 mgd	Sudbury	5.9 mgd
Wayland	3.0 mgd		
Upper Charles River Drainage Basin			
Bellingham	(50%) 0.9 mgd		
Franklin	3.5 mgd		
Holliston	1.4 mgd		
Medway	1.0 mgd	Medway	8.0 mgd
Wrentham	1.2 mgd		
Medfield	2.1 mgd	Medfield	4.0 mgd
Millis	1.9 mgd		

TABLE 2-3 (Continued). DRAINAGE BASINS, THEIR TRIBUTARY MUNICIPALITIES AND PROJECTED FLOWS FOR THE YEAR 2000

River basin	Year 2000 flow	Wastewater treatment plant Location	Year 2000 design flow
Upper Charles River Drainage Basin (cont.)			
Norfolk	Note 1	To Medway and Medfield	
Milford	3.7 mgd	Milford	3.7 mgd
North River Drainage Basin			
Hanover	2.1 mgd		
Hanson	(19%) 0.4 mgd		
Norwell	0.8 mgd		
Pembroke	0.9 mgd		
Marshfield	(10%) 0.3 mgd		
Scituate	(50%) 1.0 mgd	Scituate	5.5 mgd
Rockland	1.7 mgd	Rockland	1.7 mgd
Scituate	(50%) 1.0 mgd	To Cohasset	2.0 mgd
Taunton River Drainage Basin			
Avon	1.1 mgd	To Brockton WWTP	
South Coastal Drainage Basin			
Cohasset	1.0 mgd	Cohasset(3)	2.0 mgd
Duxbury	Note 1		
Marshfield	(90%) 3.0 mgd	Marshfield	3.0 mgd
Hull	1.0 mgd	Hull	1.0 mgd

1. Also includes Maynard.
2. To Concord River Drainage Basin.
3. Includes part of Scituate.

NOTE: 1. Does not require sewers until after the year 2000.
2. Percent is that portion of sewage flow in the basin rather than percent of land area in the basin.

Except for the Lynn and the South Essex Sewerage District wastewater treatment plants, all peripheral plants are under 10 mgd capacity, a limit we have selected for costing land disposal as the sludge management method.

At the present time, two sludge disposal plans are under consideration for the planned Lynn wastewater treatment plant. One plan would incinerate dewatered sludge on-site with sludge incinerators. The other plan consists of trucking of dewatered sludge to the steam generating solid waste disposal plant that has been constructed in Saugus to serve the solid waste disposal needs of many of the urban communities within the Metropolitan District System.

The South Essex Sewerage District will incinerate sludge that is produced at its wastewater treatment plant with its own on-site sludge incinerator now under construction.

Saugus River Drainage Basin

Saugus	Lynnfield
Lynn	Nahant

Within this drainage basin, three major sewerage systems serve Lynn, Saugus and Nahant. At present, Lynnfield is without sewerage service, but with a growing population should require such service in the near future. The wastewaters from the Lynn system which serves nearly all of the City are discharged along with the wastewaters from the Saugus system which serves 56 percent of its resident population through a common outfall to Massachusetts Bay. The Nahant sewerage system serves more than 90 percent of the town, and most of the wastewater is discharged at Bass Point to Massachusetts Bay.

Planning indicates that the combined wastewaters of Lynn, Saugus and Nahant would be conveyed to a treatment plant located in Lynn and given secondary treatment before discharge to Massachusetts Bay. Earlier studies have indicated that Lynnfield, bordering the northwestern boundary of Lynn, is more economically included in the Metropolitan District sewerage system than in the Lynn, Nahant and Saugus system. For this reason, in this conceptual plan Lynnfield is shown as part of the North Metropolitan District System.

The regional grouping of Lynn, Nahant and Saugus which is part of this conceptional plan is the most advantageous for this drainage basin. This is because

this grouping requires the least modifications to the existing sewerage systems and provides for the needs of Nahant.

In the year 2000, the treatment plant would need a capacity of 24.0 mgd (million gallons per day) as reflected by the municipal flows presented in Table 2-3.

South Essex Sewerage District

Beverly	
Danvers	Peabody
Marblehead	Salem

The South Essex Sewerage District was created by an act of the legislature in 1925 and includes Beverly, Danvers, Peabody and Salem. The State Legislature has recently passed legislation permitting Marblehead to enter the District. The present facilities provide for the collection and disposal to Massachusetts Bay of most of the wastewater originating in the District. Service is also provided to State institutions and the Ferncroft development in Middleton.

A 41 mgd primary treatment plant is under construction, and when completed the wastewater originating in the District would be afforded primary treatment before discharge to Massachusetts Bay. The District has completed and has under design relief interceptors and extensions that would improve the service within the present service area, and provide service to West Peabody. Present planning envisions the upgrading of the treatment plant to provide secondary treatment in the near future.

It is estimated that by the year 2000 the treatment facilities would require a capacity of 47.4 mgd as reflected by the flows presented in Table 2-3.

North Coastal Drainage Basin

Essex	Manchester	Swampscott
Gloucester	Rockport	

Of the five municipalities within the North Coastal Drainage basin, all with the exception of Essex provide some degree of sewer service. Two of the municipalities - Manchester and Swampscott - provide treatment before discharging wastewater to the coastal waters of the Commonwealth. The plant in the Town of Manchester, which serves approximately 64 percent of the town's population,

has recently been placed in operation as a 0.67 mgd extended aeration plant. Swampscott has a 2.5 mgd capacity primary treatment plant. Sufficient area has been reserved at this plant site to provide for secondary treatment facilities when required.

Present planning indicates that Rockport, Gloucester, and Essex are/would either construct or extend sewer service and provide wastewater treatment within their municipalities. The Rockport plant for which construction is nearly completed, would have a capacity of 2.6 mgd, the Essex plant would have a capacity of 0.4 mgd, and on the basis of published Engineering Reports, Gloucester would be served by three plants having capacities of 7.24 mgd, 0.31 mgd and 0.07 mgd, respectively. Due to differing methods used and years estimated for, the flows presented above are not the same as those reflected in Table 2-3.

Most of the coastal towns experience an appreciable increase in population during the summer months. This seasonal population tends to reside in isolated clustered groups which are adjacent to the coast. Generally, the terrain along the coast is almost solid rock and, therefore, it is extremely costly to provide a single sewer system that would serve the needs of all of these isolated areas. It is for this reason, that the City of Gloucester plans to meet their sewerage needs by providing three treatment plants.

It appears evident that providing a regional system to serve the needs of Essex, Gloucester, Manchester and Rockport is not warranted since the integration of service areas to be served by a single regional plant may not be economically justified as demonstrated in an earlier study* relating to the Regionalization of two of these communities. For this reason, the treatment plant arrangement shown in this conceptual plan follows present planning concepts.

It is estimated that by 2000, these municipalities must have sewerage facilities of sufficient capacity to accommodate the average daily flows presented in Table 2-3.

Ipswich River Drainage Basin

Boxford	Ipswich	North Reading	Wenham
Hamilton	Middleton	Topsfield	

*Whitman and Howard, Inc., Rockport, Massachusetts, "Report on Pollution Abatement Facilities and Extensions to the Sewerage System", August 1968.

Under this Conceptual Plan, it is proposed that two regional systems be developed one of which would serve North Reading and Middleton and the other Hamilton and Topsfield. The municipal plant at Ipswich would be retained. This development plan follows the general concepts outlined in the Introduction.

The Ipswich sewer system serves 37 percent of the town's population and provides primary treatment before discharging treated effluent to the Ipswich River. A small portion of Middleton and the State Institutions within that municipality are served by the town, and the wastewater is discharged to the South Essex Sewerage District. All of the remaining municipalities within the drainage basin are without sewerage service. The towns of Wenham and Boxford are not expected to require sewer service before 2000.

The Town of Ipswich has developed plans to upgrade the existing plant to provide secondary treatment. The new plant will have a capacity of 1.80 mgd. This construction is now underway. The town has also been requested by the Department of Public Health to provide mechanical sand filters followed by chlorine contact tanks, together with a study relating to the possible extension of the outfall.

The North Reading-Middleton regional plant would discharge to the Ipswich River approximately 3.7 miles upstream of the Salem Beverly water supply intake. For this reason, the plant must provide advanced treatment. This location does provide the potential for reuse. The Hamilton-Topsfield plant is located downstream of any existing or planned water supply source development.

Since West Peabody is within the Ipswich drainage basin, it would be possible to include this portion of Peabody in the North Reading-Middleton regional system. We have not proposed this because West Peabody is in immediate need of sewer service, and interceptors are now in the design stage which will permit conveyance of wastewaters from this area to the South Essex Sewerage District treatment plant.

To provide for the estimated needs of the year 2000, the Hamilton-Topsfield plant and the North Reading-Middleton plant would require capacities of 1.4 mgd and 2.4 mgd, respectively. These are in addition to the Town of Ipswich requirement of 2.4 mgd.

After the year 2000, Boxford and Wenham would become part of the Topsfield-Hamilton regional system.

The Division of Water Pollution Control in its preparation of the Phase I Basin Plans which were designed to meet 1977 goals on water quality has adopted a policy of not allowing discharge to the Ipswich River. This policy, along with other alternatives will have to be evaluated with an overall water resources plan along with present plans for diversion of additional water to the Ipswich River Basin.

Merrimack River Drainage Basin

Chelmsford (part of) Tewksbury

Chelmsford and Tewksbury do not have sewerage service. Both communities have authorized investigations and reports for the purpose of planning sewerage service within their respective communities. Tewksbury has authorized the preparation of plans and specifications for sewerage constructed within the town.

As presently planned by the interested municipalities, the wastewaters from a major portion of Chelmsford and all of Tewksbury would be conveyed to a proposed secondary treatment plant in Lowell. This plant would serve the needs of Lowell, Dracut, Tewksbury and part of Chelmsford and for this purpose would have a design capacity of 31.6 mgd.

However, it is our understanding that the average daily flow tributary to the Lowell treatment plant from Chelmsford would be limited to 5.0 mgd, and when this flow is exceeded, Chelmsford would be required to route at least the excess to another treatment plant site. Since the projected 2000 year average daily sewage flow is less than 5.0 mgd (4.19 mgd), this arrangement should be adequate for the needs of Chelmsford for a period that would exceed the design life of the Lowell treatment plant.

Since any municipal system that may be developed for Chelmsford and Tewksbury would of necessity discharge to the Merrimack River, and economics would dictate that a regional approach to the overall treatment problem of both communities would be beneficial to both, this planned regional system is retained in this concept.

Concord River Drainage Basin

Acton	Carlisle	Maynard*
Billerica	Concord	
Boxborough	Littleton (part of)	

*Located in the Assabet River Basin but to be treated with communities in the Concord River Basin.

Of the six municipalities within the Concord River drainage basin, only Billerica and Concord have sewer service and provide treatment before discharging wastewater to a neighboring water course.

The existing 0.80 mgd Billerica treatment plant is a secondary treatment plant that discharges to the Concord River. Additional treatment facilities are now under construction, so that the Billerica treatment plant in the near future would be capable of affording secondary treatment to a flow of 1.60 mgd, twice the present plant capacity.

The 1.10 mgd Concord treatment plant consists of Imhoff tanks and sand filtration beds that discharge to the Concord River through the Great Meadows Wildlife Preserve.

The Town of Concord recently authorized an investigation and the preparation of a report to determine the need for expansion of its wastewater facilities.* The study recommended upgrading the existing plant to provide advanced treatment (phosphorus and nitrogen removal) and a capacity of 2.2 mgd. It also recommended extensions to the existing sewer system, as well as undertaking such steps as were necessary to reduce the infiltration within the existing system. At the request of the regulatory agencies, the Concord investigation has been expanded to determine if the overall sewerage needs within the basin would be better served through a regional system. Under such a system, the sewerage needs of Acton, Concord, part of Littleton and Maynard would be served by a single advanced treatment facility that would probably discharge to the Concord River.

In 1966, the Town of Acton authorized an investigation and the preparation of a report to determine the need for wastewater collection and treatment facilities.** This report recommended that sewers be provided to serve a substantial part of the town, and also recommended the construction of a 1.0 mgd secondary treatment plant.

In light of the economies of scale that would be realized through the development of a single treatment plant, this conceptual plan has adopted the proposed

*Metcalf & Eddy, Inc., Concord, Massachusetts, "Additions and Improvements to Sewerage Systems," March 21, 1975.
**Metcalf & Eddy, Inc., Acton, Massachusetts, "Proposed Sewerage System," November 2, 1971.

regional system for Acton, part of Littleton, Concord and Maynard.

The Billerica plant which is undergoing upgrading, is not easily regionalized by routing wastewaters from that municipality to the Lowell or Concord regional plants. The Lowell plant has capacity limitations which would prevent Billerica from joining that system, and the Concord plant would be relocated sufficiently upstream from the Billerica outfall so that the combination of the two systems would not be economically justifiable.

Our studies indicate that the Billerica treatment plant would require a capacity of 6.4 mgd to meet the year 2000 needs.

Studies indicate that the Concord Regional treatment plant would require a capacity of 8.3 mgd to meet the year 2000 needs.

After 2000, Carlisle would become tributary to the plant in Billerica, and the Concord regional plant would provide for the needs of Boxborough.

Stony Brook Drainage Basin

Chelmsford (part of) Westford
Littleton (part of)

Chelmsford, Littleton and Westford do not provide sewerage service although the need for such service will be required in the near future. Municipal planning directed towards providing wastewater collection and treatment facilities is now underway.

As previously discussed, the major part of Chelmsford's wastewater would be routed to the Lowell treatment plant, and part of Littleton may be included in the Concord regional system. A master plan report prepared for Westford indicated that there was a need to update present wastewater collection and treatment concepts.*

Under the regional concept, wastewaters from those areas of Chelmsford, Littleton and Westford that lie within the Stony Brook Drainage Basin would be conveyed to a regional treatment plant located along Stony Brook in Chelmsford. The plant has been located so that the treated effluent can be discharged to the Merrimack River.

*Metcalf & Eddy, Inc., Westford, Massachusetts, "Master Plan," 1967-1969.

The advantages of this plan are that it minimizes the need for internal pumping in Chelmsford and Littleton; provides the benefits of regionalization to Westford; provides Chelmsford with an alternative plant to use when that municipality exceeds its allocated flow to the Lowell plant, and would permit the discharge of secondary effluent. The disadvantage is the cost of the long transport facilities that would be incurred in developing the required interceptor systems to convey wastewaters from Littleton to the treatment plant site. This increased cost, however, may be balanced by the cost difference which would occur between secondary and the advanced facility required for plants at other locations within the basin.

By 2000, the regional treatment plant in Chelmsford would require a capacity of 2.1 mgd.

Assabet River Drainage Basin

Berlin	Marlborough (part of)	Shrewsbury (outside
Bolton	Maynard*	of EMMA area)
Hudson	Northborough	Stow
		Westborough

Of the nine communities, all with the exception of Northborough, Berlin, Bolton and Stow provide sewer service. Berlin, Bolton and Stow would not require sewer service until after 2000. Maynard serves 90 percent of its present population and operates a 1.3 mgd trickling filter plant that discharges to the Assabet River. Hudson maintains a 2.0 mgd trickling filter plant which serves approximately 77 percent of the present population within the municipality. Marlborough recently completed the construction of a 2.0 mgd secondary activated sludge plant in West Marlborough. Some allowance was made for the future needs of Northborough as well as West Marlborough in determining the design capacity for this plant. Westborough and Shrewsbury are served by a 1.2 mgd secondary treatment plant, and a 1.2 mgd trickling filter plant, respectively.

The Westborough plant is capable of providing a highly treated effluent, and is presently operated at about 50 percent of design capacity. All of these plants discharge to the Assabet River or tributaries thereof.

Upgrading of the existing treatment plants or providing new treatment facilities within the drainage basin is not under study at the present time.

*Located with Assabet River Basin but to be treated with communities in the Concord River Basin.

This conceptual plan would provide one regional system and one municipal system to serve the year 2000 needs within the drainage basin. The regional system would serve Marlborough (West), Northborough, Shrewsbury and Westborough. For 2000 needs, the Marlborough plant would be expanded and upgraded to provide advanced waste treatment to serve the region. This grouping is an extension of an existing regional system in that the Marlborough plant has been designed to have capacity for the needs of Northborough.

Shrewsbury is included in the regional system since with higher effluent standards, it would be more economical to treat their wastewaters at a regional plant, than to operate and upgrade the existing plant in Shrewsbury.

Recent information reflected in the Phase I Basin Plans which cover the Marlborough, Shrewsbury, Northborough and Westborough areas indicates that Shrewsbury and Westborough should regionalize themselves instead of going to the Marlborough Westerly facility. In this case, the Marlborough Westerly Plant would receive flow from Northborough, and provide secondary treatment while the towns of Shrewsbury and Westborough would be combined into an advanced wastewater treatment facility located at a site to be determined in the future. Therefore, the present plan and the Basin Plan findings, among others, will have to be evaluated in further detail.

Under all concepts considered in this study, the Town of Hudson would expand its existing plant capacity to 3.9 mgd and upgrade the facilities to provide advanced treatment. By year 2000, the Marlborough Westerly plant would be expanded to a capacity of 9.3 mgd.

After the year 2000, Berlin would join the Marlborough regional system, and Bolton, Hudson and Stow would form a new regional system that would have an advanced regional treatment plant on the Assabet River at the Maynard-Stow town line. At that time, the Hudson treatment plant would be phased out of service.

Sudbury River Drainage Basin

Marlborough (part of)	Sudbury
Southborough	Wayland

Marlborough is the only community within this drainage basin that has sewer service and it is anticipated that the remaining communities would require sewer service before the year 2000. In addition to the "Marlborough westerly" plant located in the Assabet River drainage basin, Marlborough has a 5.5 mgd advanced treatment plant

(phosphorus removal and nitrification) that serves the eastern portion of Marlborough in the Sudbury River drainage basin.

As in the case of the Assabet River drainage basin, there is no active municipal planning to provide additional sewer service within the Sudbury River drainage basin. On a State level, the Division of Water Pollution Control is preparing a Phase I Basin Plan for the Sudbury River. Data presented in this plan indicates that discharge into the Sudbury River above Concord would not be desireable. For a longer term future, this would have to be taken into consideration in locating plants in the area or providing further regionalization in the basin.

Under this conceptual plan two regional systems are suggested, one to serve Southborough and Marlborough (East), and the other to serve Sudbury and Wayland. The advantages of this regional plan are that it permits low flow augmentation, and provides a plan that can be constructed in phases as the need for sewerage service arises within the basin. The plan further permits the concerned municipalities to realize the economies of scale that are inherent in constructing and operating a regional treatment plant.

As an alternative to the Southborough-Marlborough System, the possibility of combining Southborough with a Framingham municipal system was also investigated. This alternative will be further discussed under Concept 2.

The Sudbury-Wayland treatment plant has been located in the northern part of Sudbury along the Sudbury-Concord town line. This location has the disadvantage that it would be remote from the upstream outfalls that would serve Sudbury and Wayland, and therefore, an interceptor system would be required to carry the wastewaters from the outfalls to the plant site. However, a plant site at the suggested location has the advantage that it will permit the discharge of treated effluent downstream from the wetlands that border the Sudbury River in both Wayland and Sudbury.

To provide for 2000 needs under Concept 1, the Marlborough treatment plant (east) would require a capacity of 5.8 mgd, and the Sudbury-Wayland treatment plant (as suggested in this concept) a capacity of 5.9 mgd.

Upper Charles River Drainage Basin

Bellingham (part of)	Medfield	Millis
Franklin	Medway	Norfolk
Holliston	Milford	Wrentham

Five communities - Milford, Franklin, Medfield, Medway, and Millis provide some degree of sewer service. The Milford system serves 91 percent of the municipal population and has a 4.0 mgd trickling filter plant. Franklin which has the next largest service area serves 46 percent of the towns residents and has a system of settling tanks and lagoons for treatment. Medfield, Medway and Millis serve relatively small areas, and Medway discharges the wastewater from its service area via Great Black Swamp into the Charles River without treatment. Medfield has a new 1.5 mgd treatment plant which includes phosphorus removal. Millis has a 0.3 mgd extended aeration plant that is followed by sand filtration. With the exception of Medfield and Milford, the design capacities of the existing treatment facilities have been exceeded, and require upgrading.

A report has been prepared by the Division of Water Pollution Control on the Charles River Drainage Basin.* This report indicates that to more readily maintain the desired water quality, some degree of regionalization is warranted on the Upper Charles River basin. This report also indicates that a high degree of treatment would be required for any wastes discharged into the Upper Charles River Basin. By legislative act, the towns of Franklin and Medway have formed the Charles River Pollution Control District which has facilities planning underway including the possibility of serving North Bellingham, Holliston and Wrentham. A report has recently been prepared for Holliston, which recommends that Holliston join the Charles River Pollution Control District.** Reports are currently being prepared for the communities of Bellingham and Millis.

Under this conceptual plan, the Charles River Pollution Control District is extended to serve the towns of Holliston, North Bellingham, and Wrentham. A second regional system is developed to provide for the needs of Millis and Medfield. Both of these regional systems have the advantage that treated effluent would be used for low flow augmentation, and the concerned municipalities, particularly in the light of the anticipated stringent treatment requirements, would benefit economically by utilizing a regional approach to their sewerage needs.

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*Massachusetts Water Resources Commission, Division of Water Pollution Control, "Report on the Charles River: A Study of Water Pollution," March, 1971.

**Weston & Sampson, Holliston, Massachusetts, "Report on Wastewater Collection and Treatment," November, 1973.

The Town of Milford would retain its municipal plant, even though this plant would require upgrading to produce a higher quality effluent. This is necessary, because the Division of Water Pollution Control has indicated that there is a very real need for low flow augmentation on the upper reaches of the Charles River Basin, and because this plant can be reasonably upgraded to meet future treatment requirements.

While North Bellingham would become a part of the Charles River Water Pollution Control District, the southern part of Bellingham, because of its geographical location is better served by discharging its wastewaters into the Blackstone drainage basin, a fact which is reflected in all four of the conceptual plans presented herein.

The Charles River Pollution Control District regional treatment plant would require a capacity of 8.0 mgd, and the Millis-Medfield treatment plant a capacity of 4.0 mgd to meet 2000 needs. The Milford plant which will be upgraded to a 6.0 mgd facility providing advanced waste treatment to meet higher effluent standards will have sufficient capacity to meet the 2000 projected average daily flow.

After 2000, the Town of Norfolk would require sewerage service. To minimize internal pumping requirements, the western part of Norfolk is expected to join the Charles River Pollution Control District and the eastern part of Norfolk would join the Medfield-Millis regional system.

North River Drainage Basin

Hanover	Marshfield (part of)	Pembroke	Scituate (part of)
Hanson (part of; out of EMMA area)	Norwell	Rockland	

Within the drainage basin, Rockland has the largest sewer system, a system that serves 35 percent of the present population. Rockland has a 1.0 mgd activated sludge plant which provides secondary treatment before the effluent is discharged into French Creek. The state is currently reviewing a Facilities Plan which recommends that the existing plant be expanded to 2.5 mgd and upgraded to provide advanced waste treatment. Scituate has a 1.0 mgd secondary treatment plant that is followed by sand filtration beds. The sand filtration beds were designed to permit treated effluent to recharge the groundwater supply. None of the other towns provide sewer service within the drainage basin. However, it is anticipated

that all of these towns would require sewer service by 2000.

Both Rockland and Scituate have existing programs to extend municipal sewer service. Scituate has authorized an investigation and report to determine the need for upgrading and expanding the existing treatment plant. None of the other communities have active municipal sewer planning projects at the present time.

The quality of the water in the North River is excellent largely because of the interest of the local communities in protecting this natural resource. It has been proposed that the North River estuary be set aside as a National wildlife refuge, and that the basin be considered for water supply purposes.

Under this conceptual plan, a regional system is suggested which would provide for the needs of Hanover, Norwell, Pembroke and parts of Hanson, Marshfield and Scituate. Since northeastern Hanson is naturally tributary to the North River, this portion of Hanson is included in the regional system even though it is actually outside of the EMMA area. The existing Scituate treatment plant would be expanded, and the wastewaters from appropriate member communities would be conveyed by gravity through an interceptor constructed along the North River to this plant facility. Rockland would retain its municipal plant and upgrade that facility to advanced treatment to meet required effluent standards. This plan has the advantage that wastewaters are retained in the drainage basin of origin, that depending on the degree of treatment provided, the effluent could be reused, used for groundwater recharge, or discharged to the open sea, and that the municipalities would realize some savings in constructing and operating a regional system. It has the disadvantage that the construction of an interceptor system along the North River would pass through areas that have a potential use for water supply reservoir sites. Should this occur, it may be necessary to replace the interceptor with a pumping station and force main to bypass the reservoir.

The Division of Water Pollution Control in its preparation of the Phase I Basin Plan indicates that Marshfield and Scituate will remain by themselves providing individual municipal facilities, and that the entire town of Hanson will be included in the Old Colony District.

Further study will be required to determine solutions for Hanover, Pembroke and Norwell which may in fact require regionalization.

Taunton River Drainage Basin

Avon

Avon does not have a wastewater collection system but conditions indicate that there is an immediate need for such service.

An engineering report that was prepared for Avon recommended that the municipality develop a wastewater collection system.* The report established that the routing of wastewater to Brockton for treatment and disposal would be more advantageous to the town than joining the Metropolitan District Sewerage System.

The recommendations established in the engineering report to the town have been adopted in this conceptual plan. Accordingly, Avon is indicated as tributary to the Brockton wastewater collection and treatment system.

By 2000, the Brockton treatment plant would require sufficient capacity to treat an estimated average daily flow of 1.1 mgd from Avon.

South Coastal Drainage Basin

Cohasset	Marshfield (part of)
Duxbury	Hull

Cohasset, Marshfield and Hull provide sewer service for 5, 2 and 33 percent of their respective resident populations. Duxbury is not expected to require sewers until some time after 2000. Cohasset and Marshfield both have treatment plants. The 0.086 mgd Cohasset treatment plant is designed to provide secondary treatment, and the 0.08 mgd Marshfield treatment plant provides primary treatment. Hull which currently discharges raw wastewaters into Massachusetts Bay, has recently received an engineering report (1969) that defines the treatment and sewerage facilities that would be required to eliminate the present discharge of raw wastewaters to coastal waters, and the extension of sewer service to the entire town.** This report establishes that the development of a municipal system would be more economical for Hull than joining the Metropolitan District Sewer System. In conformance with this report and a detailed design, Hull

*Sanitary Engineering Associates, Inc., Avon, Massachusetts, "Report on Preliminary Sewerage Study," July, 1964.

**Whitman & Howard, Inc., Hull, Massachusetts, "Report on Proposed Sewerage System and Sewage Treatment Facilities," August, 1969.

is preparing to construct a secondary treatment plant with a capacity of 3.06 mgd. In this concept a new plant will be constructed in Marshfield to provide secondary treatment and the service area will be expanded to serve the entire town and small parts of Pembroke and Scituate.

This concept maintains municipal systems to serve the needs of Cohasset, Marshfield and Hull. Because part of Scituate is tributary to Cohasset, this portion of Scituate would be served by the Cohasset Plant in this concept. However, as indicated in the text relating to the North River Drainage Basin, the Phase I Basin Plan for this area indicates that Scituate and Marshfield will provide individual municipal systems, as will Cohasset.

To meet 2000 needs, the Cohasset, Marshfield and Hull treatment plants would require capacities of 2.0 mgd, 3.0 mgd, and 1.0 mgd, respectively.

After 2000 when sewer service would be required in Duxbury, Duxbury's wastewater would be routed to the Marshfield treatment plant for treatment and ocean disposal.

CHAPTER 3

CONCEPT 2 - DEER AND NUT ISLAND SERVICE AREA CONTRACTION

General

This conceptual plan would reduce the service area tributary to the Deer and Nut Island treatment plants. This would be accomplished by creating five additional regional treatment systems as shown on Figure 3-1.

Description of Plan

In this conceptual plan, the Deer and Nut Islands treatment plants would serve 32 communities including the core cities of Boston, Cambridge, Chelsea, Everett and Somerville, as shown in Table 3-1.

TABLE 3-1. MUNICIPALITIES TRIBUTARY TO DEER OR NUT ISLAND WASTEWATER TREATMENT PLANTS UNDER CONCEPT 2

Tributary to Nut Island	Tributary to Deer Island
Boston (in part)	Arlington
Braintree	Bedford
Brookline (in part)	Belmont
Dedham (in part)	Boston (in part)
Hingham	Brookline (in part)
Holbrook	Burlington
Milton (in part)	Cambridge
Newton (in part)	Chelsea
Quincy	Everett
Randolph	Lexington
Weymouth	Lynnfield
	Malden
	Medford
	Melrose
	Milton (in part)
	Reading
	Revere
	Somerville
	Stoneham
	Wakefield
	Wilmington
	Winchester
	Winthrop
	Woburn

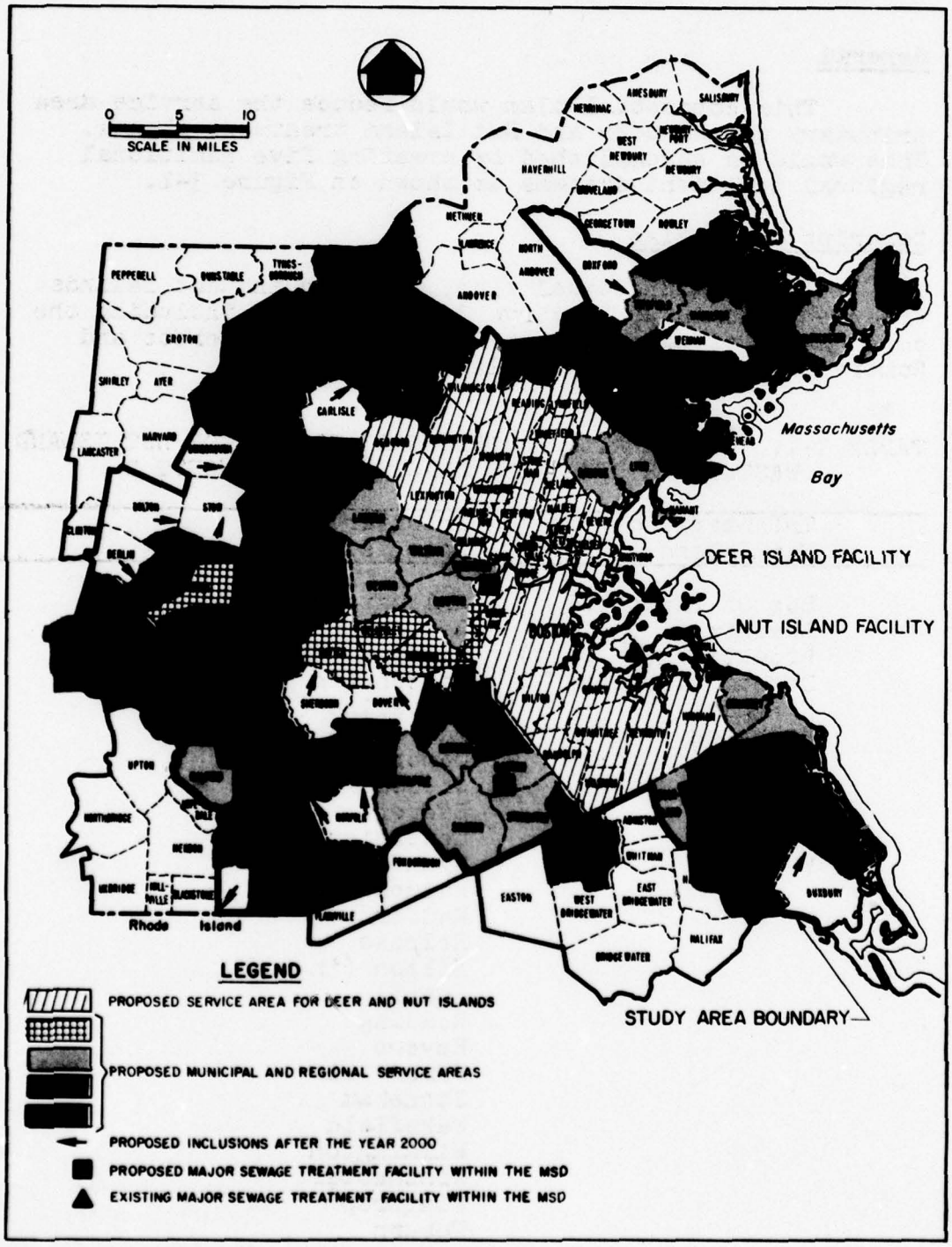

FIG. 3-1 CONCEPT 2 - A REGIONAL PLAN DEER AND NUT ISLAND SERVICE AREA CONTRACTION

The remaining communities in the present Deer and Nut Island treatment plants service area could be served as described later in this chapter.

Communities outside the present Deer and Nut Island treatment plants service area would be served as described in Chapter 2. The exceptions to this are the eastern part of Marlborough and Southborough. Under this concept and under Concepts 3 and 4, the eastern part of Marlborough would remain as a municipal system; and Southborough would join the Framingham or MDC regional system as shown in Table 3-2.

Cost of Plan

The approximate cost of providing treatment facilities and intermunicipal interceptor sewers, when applicable, under Concept 2 is on the order of $999 million as reflected in Table 2-2.

Additional Regional Treatment Systems

The five additional regional treatment systems are summarized in Table 3-2. They are each described on the following pages in further detail together with alternatives considered for each of the four river basins effected. The changes in the proposed regional and municipal systems outside the present MDC District which differ from those described for Concept 1 are also discussed hereinafter.

Sudbury River Basin. This regional system would serve Ashland, Framingham, Hopkinton and Southborough. The regional treatment plant would be located in Framingham and would discharge treated effluent to the Sudbury River. Since Ashland and Framingham are tributary to the Nut Island treatment plant and since it is anticipated under Concept 1 that Hopkinton would become tributary to that same plant, this regional system would divert nearly 19 mgd from the Nut Island Plant to the Sudbury River. This arrangement coupled with the Sudbury-Wayland regional system (5.9 mgd) has the potential of substantially improving low flow conditions in the Sudbury River. The arrangement has the further advantages that it reduces the cost of providing relief facilities for those interceptors tributary to Nut Island, and the cost of expanding the Nut Island treatment plant to meet future capacity requirements.

The Framingham regional treatment plant would require a capacity of 19.0 mgd to meet 2000 needs.

TABLE 3-2. A POSSIBLE SET OF REGIONAL SYSTEMS WITHIN EXISTING DEER AND NUT ISLAND SERVICE AREAS UNDER CONCEPT 2

River basin	Year 2000 flow	Wastewater treatment plant Location	Wastewater treatment plant Year 2000 design flow
Sudbury River Drainage Basin			
Ashland	2.6 mgd		
Framingham	14.0 mgd	Framingham	19.0 mgd
Hopkinton	1.1 mgd		
Southborough	1.1 mgd		
Charles River Drainage Basin			
Brookline	(25%)(1)1.2 mgd		
Dedham	(40%) 2.1 mgd	Dedham	29.0 mgd
Dover - combine with Dedham after 2000	---		
Natick	6.8 mgd		
Needham	7.0 mgd		
Newton	(14% NI) 1.5 mgd		
Sherborn - combine with Dedham after 2000	---		
Wellesley	5.7 mgd		
Boston (West Roxbury)	4.5 mgd		
Neponset River Drainage Basin			
Canton	(70%) 3.5 mgd	Canton	25.0 mgd
Norwood	(90%) 6.1 mgd		
Sharon	1.5 mgd		
Stoughton	4.9 mgd		
Walpole	8.4 mgd		
Canton	(30%) 1.5 mgd	Canton	5.5 mgd
Dedham	(10%) 0.5 mgd		
Norwood	(10%) 0.7 mgd		
Westwood	2.8 mgd		
Charles River Drainage Basin			
Lincoln	0.6 mgd		
Newton	(100% DI & 86% NI)	18.5 mgd	
Waltham	16.9 mgd		
Watertown	6.6 mgd	Watertown	45.0 mgd
Weston	2.6 mgd		

1. Percent is that portion of sewage flow in the basin rather than percent of land area in the basin.

Middle Charles River Basin. This regional system would serve Natick, Wellesley, Needham and parts of Dedham, Boston, Brookline and Newton. The treatment plant would be constructed in Dedham and would discharge to the Charles River. Discharge from this plant in combination with the Milford municipal system, and the Medway, Medfield regional systems, would provide substantial quantities of wastewaters for low flow augmentation in the Middle Charles River Basin. Because the service area of this regional system is tributary to the Nut Island Plant, this plan could still further reduce the need for interceptor relief and Nut Island expansion.

To meet 2000 needs in this concept, the Dedham regional plant would require a capacity of 29.0 mgd.

Some time after 2000, when the need arises, Dover and Sherborn would become tributary to this regional system.

Neponset River Basin. Two regional systems would be constructed within the Neponset River Drainage Basin. One regional system would serve the 2000 needs of Sharon, Stoughton, Walpole and part of Canton (south) and Norwood. The second regional system would serve Westwood and part of Dedham and Canton (north). All of these towns are tributary to the Nut Island treatment plant. The purpose of this arrangement is to provide low flow augmentation for the Neponset River, and to reduce the area that would be tributary to the Nut Island Plant. Wastewaters from other drainage basins would be diverted to the Neponset River.

A study of this arrangement may indicate that the construction of two regional systems in such close proximity to each other is not economically justifiable, and that regional goals may be better met through the construction of one regional treatment facility. Investigations may also indicate that the North Canton regional plant might better be combined with the Dedham regional plant, on the basis that low flow augmentation on the Upper Charles River Basin is more advantageous to the region than low flow augmentation in the lower reaches of the Neponset. In any event, this plan would have similar advantages in that the need for intersystem relief and Nut Island expansion for capacity purposes would be further reduced, if not eliminated.

To meet 2000 needs, the North and South Canton regional treatment plants would require a capacity of 5.5 mgd, and 25.0 mgd respectively.

Charles River Basin. A regional treatment plant would be constructed in Watertown to serve the needs of Lincoln, Weston, Waltham, Watertown and most of Newton. Since the municipalities of Lincoln, Weston, Waltham and Watertown are tributary to the Deer Island plant, this arrangement reduces the service area tributary to the Deer Island plant as well as to the Nut Island plant to which Newton is tributary.

In this instance, treated effluent would be used for low flow augmentation in the lower Charles River, but it also has a potential for industrial reuse since the plant would be located near industrialized areas of Watertown.

It should be recognized that even with growth in the Metropolitan District System, the sewers that are immediately tributary to the Deer Island plant would probably not require relief to handle dry weather flows. This is because most of them have been designed as combined sewers and have, therefore, a large quantity of reserve capacity at times of dry weather flows. For this reason, it is doubtful that this plan will have an advantage from a relief standpoint, but would have the advantage of reducing the amount of expansion required at the Deer Island plant to meet future needs.

With respect to the Nut Island system, the advantage would be the same as previously noted for the other regional systems, but to a more limited extent since the City of Newton is diverted from its service area. Accordingly, the major advantage in developing this regional system is the capability of utilizing treated effluent for low flow augmentation.

The Watertown regional plant would require a capacity of 45.0 mgd to meet 2000 needs.

Regional-Municipal Systems

As previously noted, most of the regional and municipal systems that are indicated in Table 2-2 would be retained in this conceptual plan. However, because Southborough is included in the Framingham Regional System, it would no longer be tributary to the Marlborough (east) treatment plant. The Marlborough (east) treatment plant would be retained as a municipal system. Southborough lies within the Sudbury drainage basin and is naturally tributary to the Framingham regional plant site. Therefore, the wastewater from Southborough would be conveyed to the plant site by gravity. This was not the case under

Concept 1 since under that concept it would be necessary to provide pumping facilities to convey wastewaters from Southborough to the Marlborough (east) treatment plant. Accordingly, this modification has some advantage to Southborough, but Marlborough loses any economic benefits that might be available from regionalization.

The Marlborough (east) treatment plant would require a capacity of 4.8 mgd to meet 2000 needs under this Concept.

CHAPTER 4

CONCEPT 3 - DEER AND NUT ISLAND SERVICE AREA EXPANSION

General

Conceptual Plan 3, as shown on Figure 4-1, would extend the Deer and Nut Island treatment plant service areas by increasing the present limits to generally include the Charles River basin in its entirety and communities around the present MDC water supplies in the Sudbury River basin. This extension would be accomplished by serving those communities that are not presently served and that are naturally tributary to the existing system. The plan does not extend service to those municiplaities that are not naturally tributary to the existing system. Their needs would be met through developing regional and municipal systems within their own drainage basins.

Description of the Plan

The Deer and Nut Island wastewater treatment plants would ultimately serve 60 communities. Table 4-1 lists the communities and indicates those communities that are tributary wholly or in part to the Nut Island or Deer Island treatment plants. In this concept, the system would be expanded to serve Hopkinton, Lincoln, Lynnfield, Sharon and Weston since these communities cannot be reasonably served by any other regional system. Further expansion would be achieved by incorporating into the system those communities that lie within the Upper Charles River basin and that are located around the present MDC water supply reservoir in the Sudbury River basin.

The remaining communities could be served as described in Chapter 2, except for the eastern part of Marlborough, which would be served as stated under Concept 2 (Chapter 3).

Cost of Plan

The estimated cost of treatment facilities and intermunicipal interceptors, where applicable, under Concept 3 is on the order of $1093 million. The major components of this estimate are given in Table 2-2.

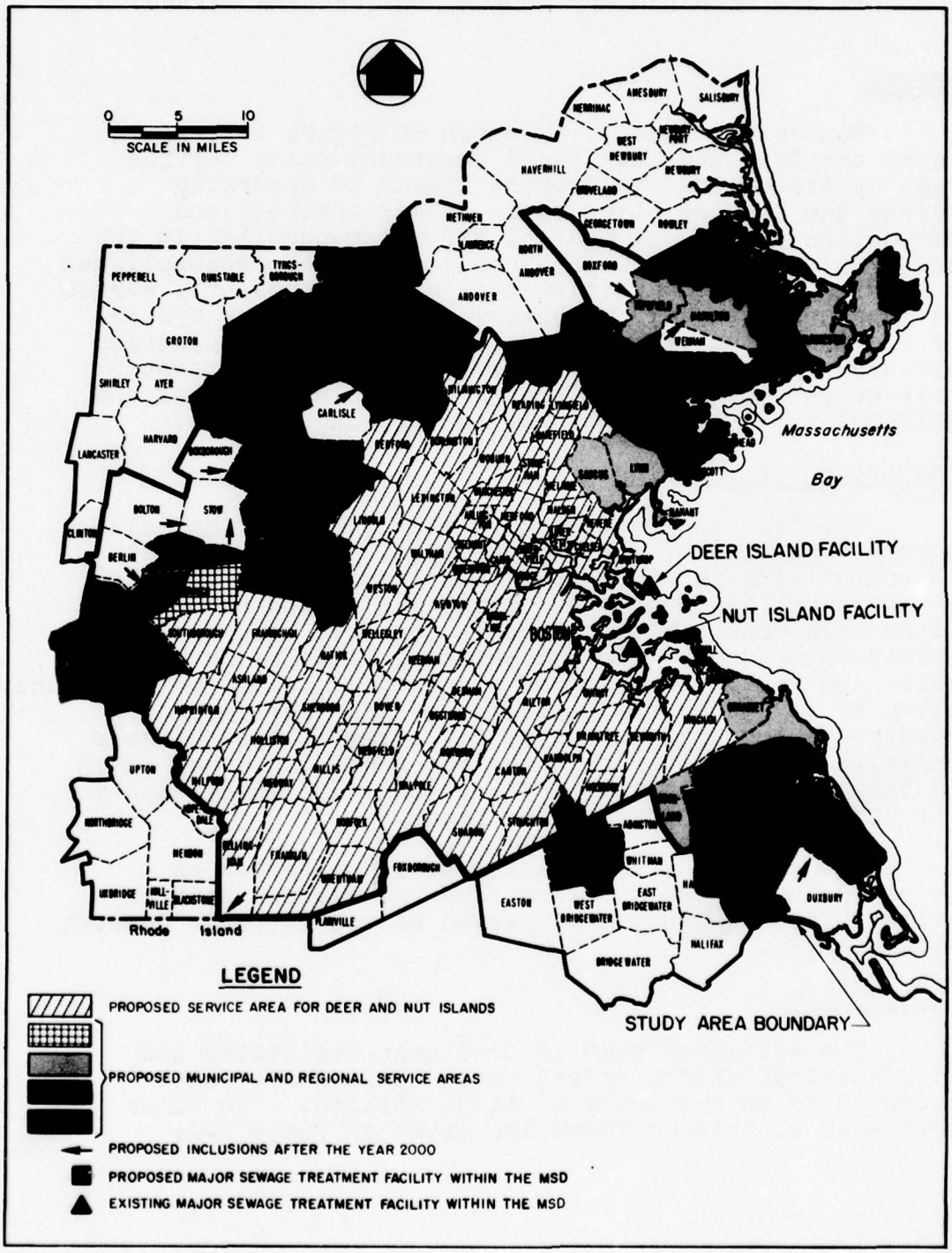

FIG. 4-1 CONCEPT 3 - A REGIONAL PLAN DEER AND NUT ISLAND SERVICE AREA EXPANSION

TABLE 4-1. MUNICIPALITIES TRIBUTARY TO DEER OR NUT ISLAND WASTEWATER TREATMENT PLANTS UNDER CONCEPT 3

Tributary to Nut Island	Tributary to Deer Island
Ashland	Arlington
Bellingham (in part)	Bedford
Boston (in part)	Belmont
Braintree	Boston (in part)
Brookline (in part)	Brookline (in part)
Canton	Burlington
Dedham	Cambridge
Dover(after year 2000)	Chelsea
Framingham	Everett
Franklin	Lexington
Hingham	Lincoln
Holbrook	Lynnfield
Holliston	Malden
Hopkinton	Medford
Medfield	Melrose
Medway	Milton (in part)
Milford	Newton (in part)
Millis	Reading
Milton (in part)	Revere
Natick	Somerville
Needham	Stoneham
Newton (in part)	Wakefield
Norfolk	Waltham
Norwood	Watertown
Quincy	Weston
Randolph	Wilmington
Sharon	Winchester
Sherborn (after year 2000)	Winthrop
Southborough	Woburn
Walpole	
Wellesley	
Westwood	
Weymouth	
Wrentham	

Metropolitan Sewerage Facilities

In Concept 1, the existing Metropolitan District System would be expanded to serve Hopkinton, Lincoln, Lynnfield, Sharon and Weston. In Concept 3, further expansion of the Metropolitan District System is achieved

by incorporating within the system those communities that lie in the Upper Charles River Basin. Communities within other drainage basins have not been included except Southborough, since they are not naturally tributary to the existing system.

With this arrangement, expansion of the Nut Island treatment plant in terms of required capacity would be maximized since the Upper Charles River Basin is tributary to the interceptor system that serves that plant.

The advantage of this system is the economic benefit that may occur to the involved towns because treatment requirements for wastewaters discharged to the open sea would not be as stringent as those required for discharge to inland waters. It is now known, however, that extensive and costly interceptor relief facilities would be required for those interceptors that are tributary to Nut Island. It therefore appears that under this concept, the cost of providing relief interceptors and expanding the Nut Island plant, would outweigh any economic benefits that result from reduced treatment requirements. The plan has the further disadvantage that it reduces the quantity of wastewater available for low flow augmentation.

Regional-Municipal Systems

The regional and municipal systems under this concept would be as indicated in Chapter 2, with the exception that the Franklin and Medway regional systems (Charles River Pollution Control District), the Millis and Medfield regional system, and the municipal system (Milford) in the Upper Charles River Basin would be eliminated.

CHAPTER 5

CONCEPT 4 - DECENTRALIZED SYSTEM

General

This conceptual plan would decentralize the present system tributary to the Nut and Deer Island treatment plants. This decentralization, as shown in Figure 5-1, would be achieved by developing six additional regional systems within the present service area of the Metropolitan District System.

Description of the Plan

The Deer and Nut Island wastewater treatment plants would serve 24 communities. Table 5-1 lists the 24 communities and denotes those communities that are tributary wholly or in part to the Nut or Deer Island treatment plants.

Table 5-2 sets forth the six additional regional systems that would be developed within the present Deer and Nut Island service areas and the municipalities that they would serve.

The remaining communities within the study area could be served as shown in Chapter 2, except that the eastern part of Marlborough would remain as a municipal system as discussed in Concept 2.

Cost of Plan

The estimated Concept 4 cost for intermunicipal interceptors and treatment facilities is on the order of $1066 million as reflected in Table 2-2.

The regional systems that are within the Sudbury River, Upper Charles River and the Charles River drainage basins have been discussed in earlier chapters. The remaining regional systems are presented in Table 5-2, and are discussed in the following paragraphs.

Mystic River Basin

Two regional systems would be developed in the Mystic River Drainage Basin. One regional system serves Burlington, Reading, Wilmington, Woburn and part of Stoneham, Wakefield and Winchester. Since the interceptor system serving

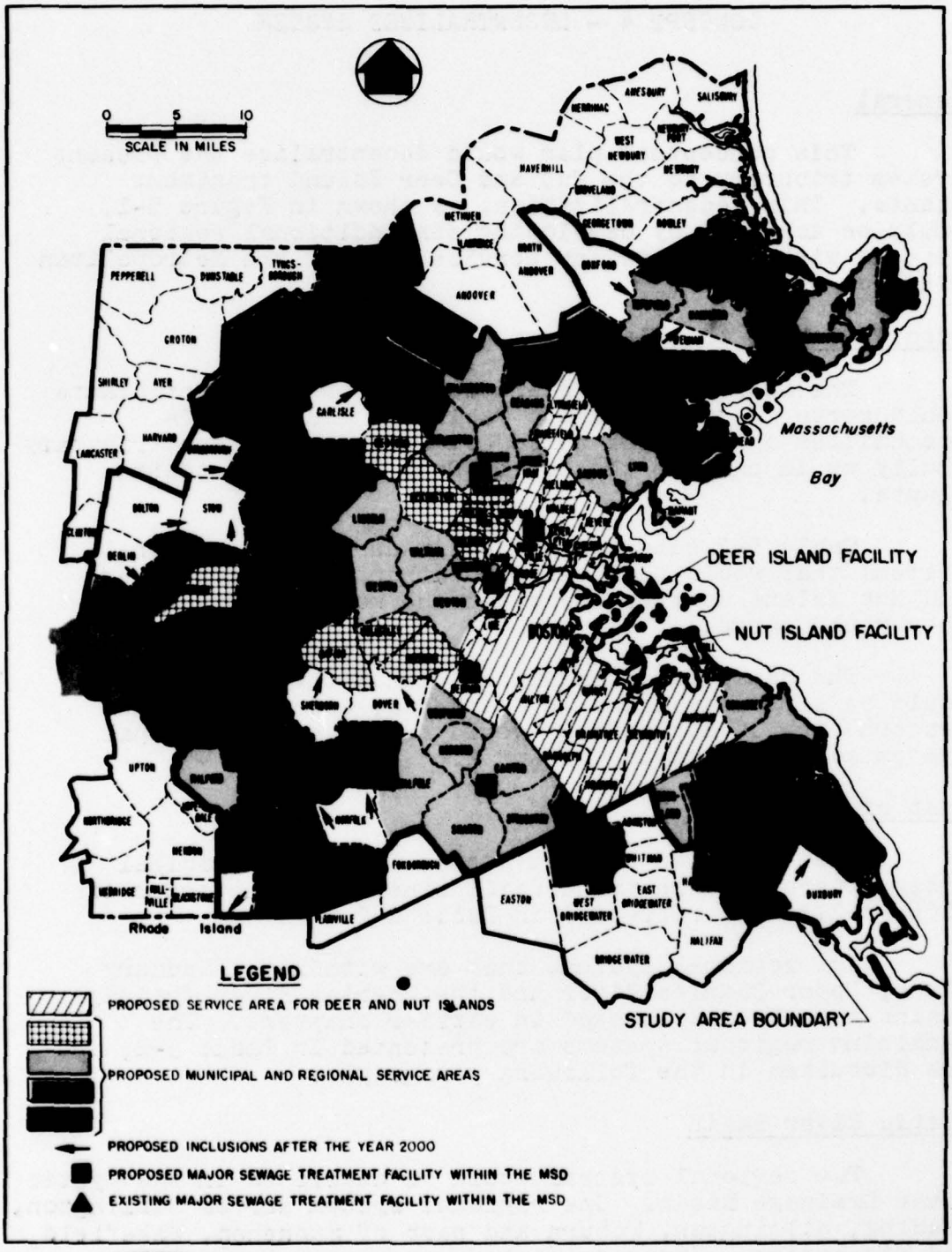

FIG. 5-1 CONCEPT 4 - A REGIONAL PLAN DECENTRALIZED SYSTEMS

TABLE 5-1. MUNICIPALITIES TRIBUTARY TO DEER OR NUT ISLAND WASTEWATER TREATMENT PLANTS UNDER CONCEPT 4

Tributary to Nut Island	Tributary to Deer Island
Boston (in part)	Belmont (in part)
Brookline (in part)	Boston (in part)
Braintree	Brookline (in part)
Dedham (in part)	Cambridge
Hingham	Chelsea
Holbrook	Everett
Milton (in part)	Lynnfield
Newton (in part)	Malden
Quincy	Medford (in part)
Randolph	Melrose
Weymouth	Milton (in part)
	Revere
	Somerville
	Stoneham (in part)
	Wakefield (in part)
	Winthrop

Burlington, Woburn and Winchester discharges downstream from the proposed plant site, pumping of the wastewater derived from these municipalities to the plant site would be required. The other regional system serves an appreciably larger area that contains Arlington, Bedford, Lexington, and part of Belmont, Medford and Winchester. The treatment plant that serves the upper portion of the Mystic River Drainage Basin would be located in Woburn, and would discharge to the Aberjona River. The second treatment plant would be located in Medford and would discharge into the lower Mystic River Basin. It can be anticipated that both plants must provide advanced treatment in order to maintain a high quality of water in the river as well as the Mystic Lakes. The Woburn and Medford regional treatment plants would require capacities of 31.0 mgd and 30.0 mgd to provide for 2000 needs.

Neponset River Drainage Basin

Under this conceptual plan, a regional treatment plant would be located in North Canton which would serve the municipalities of Sharon, Walpole, Norwood, Westwood, Stoughton and Canton. This treatment plant would discharge to the Neponset River and has a potential of providing low flow augmentation. As in the case of the Canton plants in

TABLE 5-2. A POSSIBLE SET OF REGIONAL SYSTEMS WITHIN EXISTING DEER AND NUT ISLAND SERVICE AREAS UNDER CONCEPT 4

River basin	Year 2000 flow	Wastewater treatment plant Location	Wastewater treatment plant Year 2000 design flow
Sudbury River Drainage Basin			
Ashland	2.6 mgd		
Framingham	14.0 mgd	Framingham	19.0 mgd
Hopkinton	1.1 mgd		
Southborough	1.1 mgd		
Upper Charles River Drainage Basin			
Dedham	(40%)[1] 2.1 mgd	Dedham	22.0 mgd
Dover	---		
Natick	6.8 mgd		
Needham	7.0 mgd		
Sherborn	---		
Wellesley	5.7 mgd		
Neponset River Drainage Basin			
Canton	5.1 mgd	Canton	30.0 mgd
Norwood	6.7 mgd		
Sharon	1.5 mgd		
Stoughton	4.9 mgd		
Walpole	8.4 mgd		
Westwood	2.8 mgd		
Charles River Drainage Basin			
Lincoln	0.6 mgd		
Newton	(100% DI & 86% NI) 18.5 mgd		
Waltham	16.9 mgd		
Watertown	6.6 mgd	Watertown	45.0 mgd
Weston	2.6 mgd		
Mystic River Drainage Basin			
Burlington	4.6 mgd		
Reading	4.1 mgd		
Stoneham	(85%) 4.1 mgd		
Wakefield	(10%) 0.7 mgd		
Wilmington	5.9 mgd		
Winchester	(45%) 2.2 mgd		
Woburn	9.7 mgd	Woburn	31.0 mgd
Arlington	10.4 mgd		
Bedford	3.2 mgd		
Belmont	(90%) 4.2 mgd		
Lexington	6.7 mgd		
Medford	(20%) 2.8 mgd	Medford	30.0 mgd
Winchester	(55%) 2.7 mgd		

1. Percent is that portion of sewage flow in the basin rather than percent of land area in the basin.

Concept 2, engineering studies may indicate that the wastewater flows (30 mgd) from this service area may be better routed to the Dedham regional plant and the treated wastewater used for low flow augmentation in the Charles River Basin.

Regional-Municipal Systems

The regional and municipal systems that are part of this concept are the same as those presented in Concepts 1 and 2 and discussed in Chapters 2 and 3.

CHAPTER 6

SLUDGE DISPOSAL

General

In the various concepts costs were developed on the basis that sludge incineration facilities would be provided at all of the satellite plants with flows of 10 mgd or more. These satellite plants in Concept 4 are located in Canton, Dedham, Framingham, Medford, Watertown, and Woburn. The purpose of this chapter is to present the findings of a preliminary investigation undertaken to determine the advantages and disadvantages of providing central incineration facilities for these satellite plants. Since the greatest number of satellite treatment plants occur in Concept 4, this investigation has been limited to that conceptual plan. This investigation does not include Deer and Nut Island wastewater treatment plants since sludge disposal studies for those facilities have been completed by others* and have been adopted by the MDC. Costs and recommendations from that study have been incorporated in this project.

The Department of Public Works of the Commonwealth of Massachusetts has undertaken studies to determine the economics of transporting solid wastes to primary and secondary recovery plants located in various parts of the Commonwealth.** These recovery plants would be designed to remove from solid wastes certain marketable products as metals and glass and to produce a beneficiated combustible fraction which can be sold as a fuel. This investigation considered integrating the satellite wastewater treatment plant sludge disposal systems with the proposed solid waste recovery systems and the results of that investigation are reported upon in this chapter.

Under the conceptual plans developed for this study, sludge from small peripheral wastewater treatment plants (under 10 mgd in size) would be disposed of in landfill because of the relatively smaller amounts of sludge generated,

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*"A Plan for Sludge Management," Report to The Commonwealth of Massachusetts Metropolitan District Commission by Havens and Emerson Consulting Engineers, August 30, 1973.

**A Systems Evaluation of Alternative Statewide Resource Recovery Techniques for the Disposal of Municipal Solid Waste, summary of a Report to the Massachusetts Department of Public Works, Arthur D. Little, Inc., December, 1973.

and because the location of such plants is in the less urbanized peripheral area where competition for land is less intensified. In certain cases, sludge from plants greater than 10 mgd could also be disposed in landfill. This, however, can only be evaluated after site specific plans for facilities have been developed.

Satellite Plants Regionalization

The satellite plants at Woburn, Medford, Watertown, Canton, Dedham, and Framingham under Concept 4 are of sufficient capacity to warrant providing incineration facilities for sludge disposal. Such an arrangement is shown in Figure 6-1. With the installation of incineration facilities at each location, thickeners and vacuum filters must also be provided to precondition the sludge for incineration.

As alternatives to providing incineration facilities at each individual satellite plant, we have considered two other arrangements as illustrated on Figures 6-2 and 6-3 and as presented in Table 6-1.

TABLE 6-1. ALTERNATIVE REGIONAL SLUDGE MANAGEMENT SERVICE AREAS

Alternative No.	Incinerator location	Satellite plants served
2	Dedham	Canton
		Dedham
	Framingham	Framingham
	Medford	Medford
		Woburn
	Watertown	Watertown
3	Dedham	Canton
		Dedham
		Framingham
	Medford	Medford
		Watertown
		Woburn

Under both the alternatives presented in Table 6-1, transportation of sludge to the central incinerator facility from the satellite plants served by that facility will be required. This may be accomplished by either trucking or

FIG. 6-1 LOCATION OF INCINERATION FACILITIES FOR SATELLITE TREATMENT PLANTS-ALTERNATIVE 1

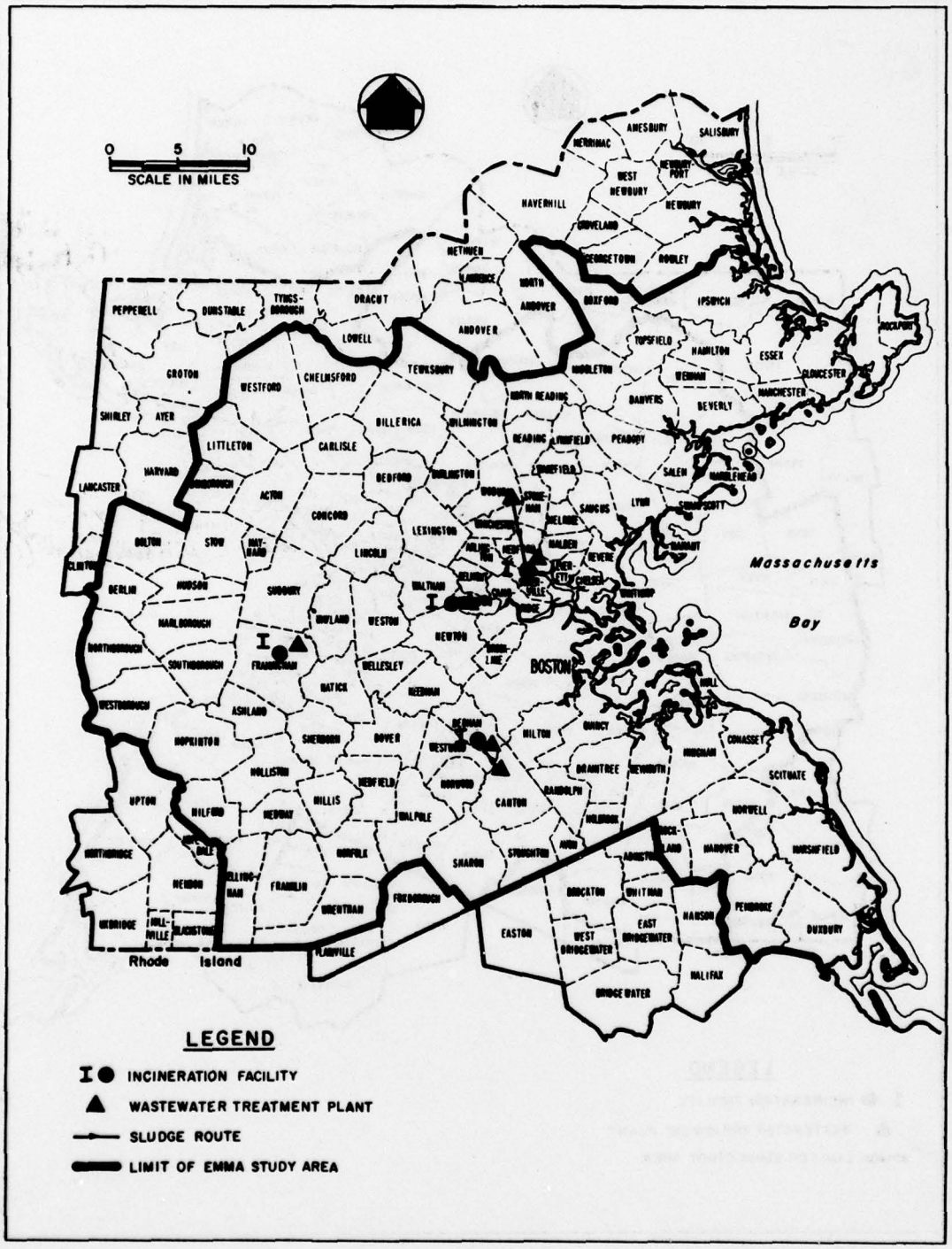

FIG. 6-2 LOCATION OF INCINERATION FACILITEIS FOR SATELLITE TREATMENT PLANTS-ALTERNATIVE 2

FIG. 6-3 LOCATION OF INCINERATION FACILITIES FOR SATELLITE TREATMENT PLANTS-ALTERNATIVE 3

by pumping sludge to the applicable sludge handling locations.

If it is elected to truck the sludge to the central incinerator facility, thickeners and vacuum filters should be provided at each satellite plant. This is because the sludge must be conditioned to such a point where it may readily be handled in truck transport. If this is done, the sludge received at the incineration facility will have been sufficiently conditioned to permit direct incineration without further processing. On the other hand, if it is elected to pump the sludge, then it is best not to provide thickening and vacuum facilities at each satellite plant since preconditioned sludges are not of such a consistency to permit them to be readily pumped. In this case, additional thickeners and vacuum filters will be required at the incinerator facility to precondition the sludge before incineration.

Trucking requirements that are applicable to Alternatives 2 and 3 are presented in Table 6-2.

TABLE 6-2. TRUCKING REQUIREMENTS

From	To	No. of trucks used	Truck capacity cu yd	Haul distance oneway miles	No. of trips per day per truck(1)
Framingham	- Dedham	7	20	25	2
Canton	- Dedham	4	20	6	5
Watertown	- Medford	8	20	7.5	4
Woburn	- Medford	5	20	6.5	4

1. Based on 5 day operation per week, 8 hour operation per day, average speed of 20 miles per hour, and layover time at each end of haul of 30 minutes.

Pumping station capacities and force main facilities that will be required for Alternatives 2 and 3 are presented in Table 6-3.

TABLE 6-3. PUMPING STATION AND FORCE MAIN REQUIREMENTS

From	Pumping station capacity, (gpm)(1)(2)	Force main Diameter, (in.)	Force main Length, (miles)
Framingham to Dedham	425	8	16.0
Canton to Dedham	700	10	4.5
Watertown to Medford	1,050	12	5.7
Woburn to Medford	425	8	4.7

1. Gallons per minute.
2. Based on 24 hour operations per day - seven days per week.

For each alterantive, and for each mode of transport, the capital and annual operating costs were determined. Capital costs include, as applicable, the cost of providing incinerators, pumping stations, force mains and auxiliary facilities required to handle sludge delivered by truck transport. Capital costs have been determined at present day prices (ENR 2200), and include a 35 percent allowance for engineering and contingencies.

Annual costs include, as applicable, the cost of labor, power, fuel, maintenance, supplies, insurance, taxes, and license fees. Annual costs have been determined at present day prices. Tables 6-4 and 6-5 present the total annual cost that would be incurred for each alternative.

Tables 6-4 and 6-5 indicate that Alternative 3, with the largest degree of regionalization is the more economical alternative, regardless of the method of transportation.

On the basis of the preceeding analysis, consideration should be given to regionalization of sludge management facilities that will serve the satellite plants with regard to the method that should be utilized on transporting the sludge, the evidence is not so clear on the basis of cost and may well be ultimately determined on environmental factors rather than economic considerations.

TABLE 6-4. CAPITAL, ANNUAL OPERATING AND TOTAL ANNUAL COSTS FOR TRUCKING OPTION

	Alternative 1	Alternative 2	Alternative 3
Incinerator location	At each satellite plant	Dedham Medford Framingham Watertown	Dedham Medford
Capital cost	$68,700,000	$59,000,000	$47,900,000
Capital cost amortized - 20 yr. 6-7/8 percent interest rate[1]	6,423,000	5,517,000	4,478,000
Annual operating cost	4,810,000	4,736,000	4,858,000
Total annual cost	$11,233,000	$10,253,000	$ 9,336,000

1. "Facilities Planning Summary" U.S. Environmental Protection Agency, January 1974.

TABLE 6-5. CAPITAL, ANNUAL OPERATING AND TOTAL ANNUAL COSTS FOR PUMPING OPTION

	Alternative 1	Alternative 2	Alternative 3
Incinerator location	At each satellite plant	Dedham Medford Framingham Watertown	Dedham Medford
Capital cost	$68,700,000	$60,509,000	$52,655,000
Capital cost amortized - 20 yr. 6-7/8 percent interest rate	6,423,000	5,658,000	4,920,000
Annual operating cost	4,810,000	4,495,000	4,242,000
Total annual cost	$11,233,000	$10,153,000	$ 9,162,000

Disposal with Other Solid Wastes

Under the study prepared for the Massachusetts Department of Public Works, it is proposed to provide a 3,000 ton capacity primary solid waste recovery plant in the vicinity of the intersection of Route 128 and the western section of the Massachusetts Turnpike and also in the vicinity of Routes 128 and I-93. Both of these locations are in reasonable proximity of sites for wastewater treatment plants in Concept 4. Since previous analysis has indicated that regionalization of incineration facilities for the satellite plants is cost effective, the question arises if it would be beneficial in the future to eliminate all incineration facilities and truck all of the sludge to a solid waste recovery plant for disposal.

A primary solid wastes recovery plant consists of equipment that will shred, dry and separate nonferrous metals, glass and ferrous metals from the solid wastes. The process produces a beneficiated combustible fraction that has a market valve as a fuel. These plants are designed to handle solid wastes that are expected to have a moisture content of approximately 24 percent.

Vacuum filtration of wastewater sludges, usually produces a filter sludge cake that has a moisture content of 75 to 80 percent. To produce a sludge equivalent in moisture content to solid wastes, additional drying will be required. This is best accomplished at the primary resource recovery plant, because the beneficiated combustible fraction could be used as an economical source of fuel for this purpose. The sludge disposal process would consist of thickening and vacuum filtration at the wastewater treatment plant site, the transportation of filter sludge cake to the primary resource recovery plant, and the drying of the sludge which could be accomplished in the drying facilities that are part of the primary resources recovery plant system.

Our analysis indicates that if all of the sludge produced by the satellite plants were processed at the nearest primary resource recovery plant, only 4 to 6 percent of the recovery plant's design capacity would be utilized, at a sludge moisture content of about 24 percent. Furthermore, it appears that at that moisture content, the heat value and ash content of the beneficiated combustible fraction would not be adversely effected by adding wastewater sludge to the process. Accordingly, the market value of the beneficiated combustible fraction may not be diminished if this process was used for sludge proposal.

Under Concept 4 sludge from the satellite plants could be pumped to either the Dedham or Medford wastewater treatment plants for further dewatering, or processed directly at the satellite plants. In any event, the resulting filter sludge cake would be transported by truck to the applicable primary resource recovery plant as shown on Figure 6-4.

The additional cost incurred would be for trucking the sludge to the primary resources recovery plant, operating and providing the drying capacity required, and for providing, operating, and maintaining the primary resource recovery plant. A saving in cost would be realized because it would no longer be necessary to provide, operate and to maintain sludge incineration facilities. Under Concept 4 this saving could be on the order of four dollars per ton of wet sludge produced. An additional cost benefit would be realized, since a marketable product is produced by the primary resource recovery plant.

It should be noted that the Massachusetts Department of Public Works intends to receive bids from private industry for the construction and operation of solid waste disposal facilities. The successful bidder would select the solid waste disposal system subject to the approval of the Department. It is, therefore, not certain that solid wastes would be disposed of through a resource recovery system that is designed to produce a beneficiated combustible fraction. Other systems that are primarily designed to generate steam or combustible gas could be used depending on the particular needs within the vicinity of the solid waste disposal plant. Accordingly, the best that can be said at the present time is that disposing of sludge along with solid wastes is technically possible and may be in this particular case economically and environmentally justifiable. Accordingly, it is indicated that further investigation of this matter is warranted during detailed engineering investigations of facilities.

Peripheral Plants

With the exception of the Lynn regional and the South Essex Sewerage District, wastewater treatment plants in the peripheral area would be under 10 mgd capacity, and would be expected to utilize land disposal of sludge.

In the case of these two plants, sludge would be incinerated.

FIG. 6-4 SLUDGE DISPOSAL WITH SOLID WASTES